

FUNDAMENTALS OF
WIRELESS
TELEGRAPHY



PRICE 25 CENTS

PUBLISHED BY
SIGNAL ELECTRIC MFG. CO.
MENOMINEE, MICHIGAN

Printed in U. S. A.

FOREWORD

THROUGH courtesies extended by the R. C. A. Institutes, Inc., this booklet, "The Fundamentals of Wireless Telegraphy," is issued.

The purpose of this booklet is to give you only the fundamentals of Wireless Telegraphy. It is not a complete course. There are other books and courses available which will give the beginner complete information regarding this wonderful system of wireless communication.

ACQUIRING THE CODE

In acquiring the code the beginner should adopt the "sound" method. Usually so many beginners first memorize the code by the "visual" method, that is, studying from a code card or chart without the aid of a key and buzzer or other sound-producing device, with the result that considerable time is spent in getting the "picture" of dots and dashes out of mind. When a student memorizes the code by the visual method he pictures each character as being comprised of so many dots or dashes and, when endeavoring to receive signals, he unthinkingly visualizes each dot and dash before writing the characters which are transmitted. Unless the sound method is adopted no appreciable receiving speed can be attained. This is logical when it is considered that it would be impossible for an operator to receive, say twenty or more words per minute, if he first had to think of each character as being composed of so many dots or dashes before copying.

Acquiring the code is similar to learning a new language; after all, the code is a language. It can be imagined how difficult ordinary conversation would be if the conversants had to define each word mentally before grasping its meaning; similarly it would be difficult to master the code at any appreciable speed if each transmitted character should first have to be defined as being composed of so many dots and dashes.

The foregoing paragraph should not be construed as meaning that the code cannot be acquired by the student who has unfortunately memorized it by the visual method. By adopting the sound method this system of learning would gradually be mastered, but a great deal of valuable time would be lost meanwhile. The sound method, which is becoming the universal system of instruction, trains a student in such a manner that, upon hearing a character, he translates it immediately and instinctively into the letter for which it stands. He does this subconsciously to a certain degree, dependent upon the amount of practice involved, and does not find it necessary to visualize dots and dashes.

The first step in acquiring the code is to learn the sound of each letter, numeral and character. A buzzer practice set (key and buzzer and dry cell), or equipment which will answer the same purpose, should be employed. The alphabet should first be learned, then the numerals, punctuations and other characters.

The following code chart may be used as a guide for the beginner. The authors have taught thousands of code students and have tried practically every known method and system of code instruction and this experience has proven the method given here to be the most advantageous.

To avoid learning the alphabet in sequence, that is, A, B, C, D, etc., the student should master it by concentrating on the groups shown, first studying Group 1 until the characters can be transmitted without referring to them, then studying the following groups, one at a time, until Groups 1 to 10, inclusive, will have been memorized. Group 11 may be studied later, say when the student can receive at a speed faster than five words a minute.

When the characters in Groups 1 to 10 are thought to be memorized the student may transmit the exercises at the bottom of page 4 several times as a means of determining whether or not he readily remembers them.

CHARACTERS OF THE INTERNATIONAL MORSE CODE

GROUP 1

E 
I 
S 
H 

GROUP 2

T 
M 
O 

GROUP 3

A 
U 
V 
W 

GROUP 4

J 
R 
L 
F 

GROUP 5

N 
D 
B 
G 

GROUP 6

K 
C 
Y 
Q 

GROUP 7

P 
Z 
X 

NUMERALS

GROUP 8

1 
2 
3 
4 
5 

GROUP 9

6 
7 
8 
9 
0 

PUNCTUATIONS

GROUP 10

PERIOD 

COMMA 

INTERROGATION 

ERROR 

PUNCTUATIONS AND CONVENTIONAL SIGNALS

GROUP II

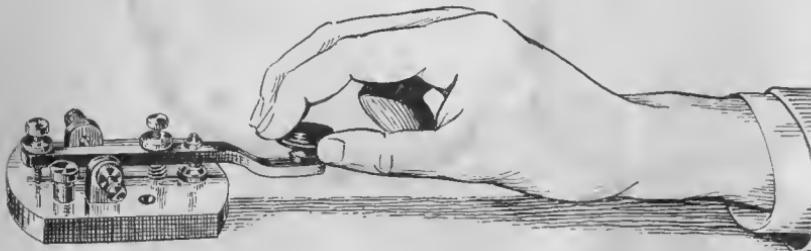
SEMICOLON	██████████	GENERAL INQUIRY CALL	██████████
COLON	██████████		██████████
EXCLAMATION	██████████	INVITATION TO	
APOSTROPHE	██████████	TRANSMIT	████
HYPHEN	██████████	WARNING HIGH	
FRACTION BAR	██████████	POWER	██████████
PARENTHESIS	██████████	QUESTION (REPEAT)	
INVERTED COMMAS	██████████	AFTER	
UNDERLINE	██████████	INTERRUPTING	
DOUBLE DASH	██████████	LONG MESSAGE	██████████
FROM (DE)	██████ □	POSITION REPORT (TO	
WAIT	██████████	PRECEDE POSITION	
UNDERSTAND	██████████	REPORTS)	████
RECEIVED (OK)	██████	TRANSMISSION FINISHED	
ATTENTION CALL	██████████	END OF COMMUNICATION)	
DISTRESS CALL	██████████	██████████	██████████
		END OF MESSAGE	██████████

adjunct	quadruple	B63FH	yawl
oxen	pulverize.	9V48F	quack.
very	16502	23748.	knuckle
wirc	rejoicc	zenith	ZC38B.
83726	waffle	50091,	vexation
gypsum	athletic	NQZ37	zebra
yell,	injct	HS85VB	quiz,
grazc	31974	PZ2WN	xray
fuse	failurc.	selfish	J91B6
94051	perhaps	A48FK.	little,
oxygen	zephyr	38020,	lull
cyclonc.	quickness.	KZPQC	TZ43P
embczzle	hexagon	9YCQY	V32HN
zero	86502	riffle	YAVVU
bicycle	reflex	HK37X	WITYZ
89347	obnoxious	28XKB	40207.
quaint	yacht.	N6166	INJDL
dyspeptic	cognize	4HN6K	crazy
rabble.	affix,	3YHF7	WLTSH
bordeau	buzzard	82LVK	F3Z8Y

The characters which prove most difficult to recall instantly to mind should receive special attention until they are readily recalled.

KEY MANIPULATION

The correct method of operating the key in sending is by a forearm movement. As shown in the illustration, figure 1, the elbow should be



(Fig. 1. Showing correct position of hand, wrist and elbow when sending)

placed on the table and used as a fulcrum, the wrist clearing the table one to two inches, the thumb just underneath the outer edge of the key button, the index and second fingers curved sharply at the knuckles and placed just slightly over the back of the key button and the key operated by free-arm movement; that is, the energy required to manipulate the key should be expended from the forearm and wrist, and not from the hand and fingers. The wrist should go downward when each dot or dash is made. There should be no trace of rigidity in the hand and fingers while transmitting. Hand key sending may be compared to hand writing; the free-arm writer can write legibly for a much longer period than can the writer who writes with his fingers tautly gripping his pencil and who expends the required energy from his hand and fingers only.

No hard and fast rule should be established on exactness in the position of the arm, hand and fingers during transmission. If sending is more easily accomplished by placing three fingers on the key button, and the characters more evenly "rounded out" by a two to three-inch clearance between the wrist and table, this slight difference of form may be adopted. Free arm sending—each dot and dash made by the wrist and arm—should be the aim.

The dots and dashes of the code are made in the same manner; the length of time during which the key is held down determines which are dots and which are dashes. No more pressure should be applied to the key when making a dash than that which is applied when making a dot. The dash is three times longer than the dot. The space between each letter or character in a word is equal to three dots and the space between words is equal to five dots. The student should - - - thinking of the formation of "C" - - - instruction when sending (cross) - - -

As progress is made finished (end of work) (conclusion of There should be no nish) - - - - - be no division of the nce) - - - - - letter "C" is divided

INTERNATIONAL MORSE CODE AND CONVENTIONAL SIGNALS

To be used for all general public service radio communication

1. A dash is equal to three dots.
2. The space between parts of the same letter is equal to one dot.
3. The space between two letters is equal to three dots.
4. The space between two words is equal to five dots.

1 . - - - -

2 . - - - -

3 . - - - -

4 . - - - -

5 . - - - -

6 - - - -

7 - - - -

8 - - - -

9 - - - -

0 - - - -

Ä (German)

Å or Å (Spanish-Scandinavian)

- - - -

CH (German-Spanish)

- - - -

È (French)

- - - -

Ñ (Spanish)

- - - -

Ö (German)

- - - -

cognac

affix,

buzzard

A - -

B - - - -

C - - - -

D - - - -

E -

F - - - -

G - - - -

H - - - -

I - - - -

J - - - -

K - - - -

L - - - -

M - - - -

N - - - -

O - - - -

P - - - -

Q - - - -

R - - - -

S - - - -

T -

U - - - -

V - - - -

W - - - -

X - - - -

Y - - - -

Z - - - -

quaint
dyspeptic
rabble.
bordeau

cognac

affix,

buzzard

3YH7

82LVK

The characters which prove most difficult to recall should receive special attention until they are readily recalled.

Period	• • • •
Semicolon	— - - -
Comma	• - - -
Colon	- - - -
Interrogation	• - - - -
Exclamation point	- - - - -
Apostrophe	• - - - -
Hyphen	- - - -
Bar indicating fraction	- - - -
Parenthesis	- - - - -
Inverted commas	• - - - -
Underline	• - - - -
Double dash	- - - -
Distress Call	• - - - - - -
Attention call	- - - -
General inquiry call	- - - - - -
From (de)	— - - -
Invitation to transmit (go ahead)	- - -
Warning—high power	- - - - -
Question (please repeat after)— interrupting long messages	• - - - -
Wait	• - - - -
Break (Bk.) (double dash)	- - - -
Understand	• - - - -
Error	• - - - -
Received (O. K.)	- - -
Position report (to precede position messages)	- - - -
End of each message (cross)	- - - -
Transmission finished (end of work) (conclusion of correspondence)	• - - - -

Period	• • • •
Semicolon	— - - -
Comma	• - - -
Colon	- - - -
Interrogation	• - - -
Exclamation point	- - - -
Apostrophe	• - - -
Hyphen	- - - -
Bar indicating fraction	- - - -
Parenthesis	- - - -
Inverted commas	• - - -
Underline	• - - -
Double dash	- - - -
Distress Call	• - - - - -
Attention call	- - - -
General inquiry call	- - - - -
From (de)	— - - -
Invitation to transmit (go ahead)	- - -
Warning—high power	- - - -
Question (please repeat after)— interrupting long messages	• - - -
Wait	• - - -
Break (Bk.) (double dash)	- - - -
Understand	• - - -
Error	• - - -
Received (O. K.)	— -
Position report (to precede position messages)	- - - -
End of each message (cross)	- - - -
Transmission finished (end of work) (conclusion of correspondence)	• - - -

Period	• • • •
Semicolon	— - - -
Comma	• - - -
Colon	- - - -
Interrogation	• - - -
Exclamation point	- - - -
Apostrophe	• - - -
Hyphen	- - - -
Bar indicating fraction	- - - -
Parenthesis	- - - -
Inverted commas	• - - -
Underline	• - - -
Double dash	- - - -
Distress Call	• - - - - -
Attention call	- - - -
General inquiry call	- - - - -
From (de)	— - - -
Invitation to transmit (go ahead)	- - -
Warning—high power	- - - -
Question (please repeat after)— interrupting long messages	• - - -
Wait	• - - -
Break (Bk.) (double dash)	- - - -
Understand	• - - -
Error	• - - -
Received (O. K.)	— -
Position report (to precede position messages)	- - - -
End of each message (cross)	- - - -
Transmission finished (end of work) (conclusion of correspondence)	• - - -

ly the letter "Q" would be copied as "MA." When it is found that transmission is becoming cramped, relax the forearm and wrist muscles for a few seconds and begin anew. As a beginner avoid fast transmission. Endeavor to maintain always a sending speed of not more than three words per minute faster than your receiving speed. If you can receive four words per minute you should not send faster than seven words per minute.

Before beginning his sending practice it should be desirable for the student to obtain a two or three-minute preliminary or "warming up" exercise by transmitting the characters V, Q, G and Z. During this preliminary exercise particular attention should be given to the position of the hand, arm and elbow, making certain that the correct position is maintained. While transmitting the four characters the student should ascertain that he is proceeding rightly by bearing in mind the following:

- (1) Position of hand, arm and elbow.
- (2) Full arm and wrist motion.
- (3) Absence of rigidity in hand and fingers.
- (4) Uniform formation of characters.
- (5) Proper spacing of characters.
- (6) Maintaining proper sending speed according to receiving ability.

It will be noted that there are only four signals which are spaced. These are: Period, "From (de)" signal, General Inquiry Call, and Position Report Signal. In transmitting the period it would be sent as three I's; the "From" signal as de; "General Inquiry Call" as CQ, and the "Position Report" signal as TR.

It has been rightly said that a telegraph operator is no better than his sending. There are by far too many poor senders actively engaged in radio communication. Whether they have so easily acquired, along the lines of least resistance, a faulty style or method of transmission or because of utter indifference to the telegraph profession, is generally unknown. There is, however, nothing more pleasant to the real telegrapher's ear than evenly spaced and well rounded out characters. While sending always keep in mind the operator who is receiving you and endeavor to give him as little trouble as possible. Nothing is quite so disconcerting to the receiving operator as poor spacing. Poorly executed characters may be read by an experienced and skillful operator, but when in addition they are poorly spaced, receiving becomes a hard task. The fingers should not be taken away from their position on the key until transmission is entirely finished.

In calculating transmitting or receiving speed, five letters or characters are counted as one word. For example, the word "proportionately," consisting of fifteen letters, is counted as three words; the words "in the," containing five letters, are counted as one word. The sentence, "we will report Thursday at 7 P. M.," containing twenty-five letters, is five words. (The foregoing examples are used to determine receiving or transmitting speed.)

ADJUSTMENT OF KEY

The adjustment and location of the telegraph key is important. The gap between the contacts should be at least one-thirty-second of an inch.

A too finely spaced contact tends to create a nervous style of sending and, on the other hand, if too much spacing is provided between the contacts the sending is likely to be "muddy" and heavy. The contacts should be spaced by the rear key screw only; not by the side screws. The side screws are for the purpose of aligning the contact points and, if screwed up tightly, will cause binding. They should be screwed up to the setting which prevents any appreciable amount of side-play.

The adjustment of the spring should be carefully looked after—there should be only that amount of spring tautness that will immediately break the circuit when the pressure applied to the key is released; more spring than is necessary causes the expenditure of unnecessary energy.

The key should be placed in such position as will enable the elbow to rest on the table.

HAND KEYS

Telegraph keys provided by the various operating companies are of a type similar to that shown in Figure 1. Many radio operators use a Sematic Key, or "side-swiper." (See Figure 2).



Figure 2.

In the hands of one skilled in their use signals sent by a Sematic Key are very easily copied. Unquestionably this key is a labor-saving device and it permits considerably faster and better transmission. Unfortunately the beginner endeavors to use it in moving traffic before he masters its peculiarities, with the result that time is lost and interference created. Usually the new operator will try his skill in manipulating the Sematic Key by transmitting a radiogram to a shore-station. The shore-station operator, who has years of experience and who can copy the poorest of sending, receives the radiogram—the new operator is then, in his own estimation, proficient in using this key. He sends his next message to a ship, the operator on which may be a man of little operating experience, or he may be on his first assignment. The shipboard operator cannot copy the faulty signals sent by the Sematic Key, and the result is that time is lost and interference probably created. This should indicate to the new operator that more practice is required, yet because the experienced shore-station operator copied his signals with seemingly no difficulty he thinks himself a master of the Sematic Key.

RECEIVING

The three chief causes of the student's slow progress in receiving the code are: (1) learning the characters visually, (2) hesitating over a character, thereby losing one or more following characters, and (3) looking back over that which has been copied, thereby momentarily disrupting concentrativeness.

After the characters have been memorized by the beginner, that is, after the beginner can send them without referring to the groups or a code chart, he should begin receiving at a speed of two words (ten characters) a minute. If a letter is missed do not interrupt the sender. Copy what you can and after the transmission is finished check the copied characters to ascertain those which require more practice. In a few hours the dots will be readily distinguished from the dashes; from then on progress can be made only by copying at a speed slightly faster than you can accurately receive.

The code can not be acquired in a day and because progress is seemingly slow many beginners become discouraged in a short time. Determination, concentration, and consistent application are the requirements for acquiring the code in a minimum length of time.

Other difficulties encountered by code students may be summed up as follows:

(1) Getting rid of the visual picture of the characters as being composed of dots and dashes.

(2) Trouble with a few characters. This indicates a lack of practice on these characters.

(3) Consciousness of writing. Forget that you are writing—write in your natural hand, confining your thoughts to the sound of the signals.

(4) Printing. Do not print any letters or characters until you can receive at least ten words per minute. A beginner has enough to think of in receiving without mastering another subject while receiving.

(5) Hesitating over missed letters. When a letter is missed forget it. By attempting to recall it to mind several characters will probably be missed.

(6) Wandering of mind. This denotes weak will power or over-concentration.

(7) Over-concentration. When you become tense due to over-concentration, or "hard thinking," completely relax for a few seconds and begin again.

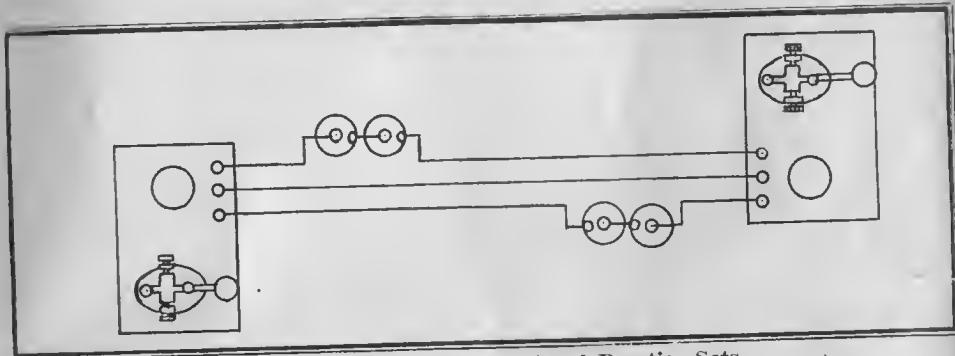
(8) Fatigue. When the dots and dashes seem undistinguishable and several characters are lost, it is usually because the student is mentally fatigued. In such condition you should completely relax for a few seconds. No form of work is more exacting than that of copying code for an appreciable length of time. As more hours are spent in receiving it will be found that the mind will gradually become accustomed to its new task and, after more and more receiving practice, the student can copy unbrokenly over a longer period of time.

It is in the early stages of code practice that future habits are formed and the student should therefore have just one idea continually in mind—ACCURACY. Great care should be exercised to have every dot, every dash, every letter, as perfect as it is possible to make it.

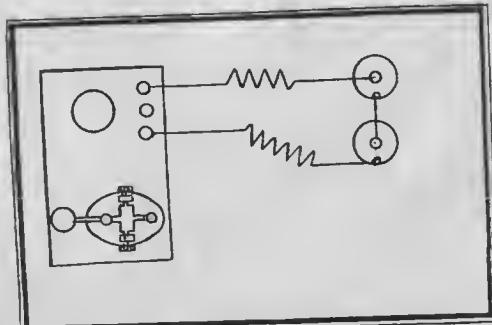
The student who lays a solid foundation of accuracy in code transmission will have a better foundation upon which other things, such as speed, can be built later on. A good rule to follow is to make each dot short and sharp, but firm, and each dash long enough—the length of three dots—that it will be impossible to mistake one for the other.

TRANSMITTING SPEED

No operator should transmit at a speed faster than he can receive. Much time is lost and considerable interference is often created by inexperienced operators who persist in sending, say, 25 to 30 words a minute when they are unable to receive scarcely faster than 20 words per minute. Usually an operator's receiving ability is gauged by the speed at which he transmits and, in telegraph communication, he will almost invariably be answered and transmitted to at a speed as fast as he maintains in sending. There are, of course, exceptions; many "old-timers" never send faster than 25 words per minute, whereas they would have no difficulty in receiving at faster speeds. These operators are known to the majority of other experienced operators by their method and style of transmission.



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Showing Hook-up of Single Signal Practice Set



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This type buzzer is the same as used on our R-68 practice set. It is adjustable. Has standard resistance of 2 ohms. Can be furnished in special resistances on quantity orders. Black crystalized lacquer finish.

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Brass base, heavily insulated, 3 contact sizes of coin silver, sturdy construction.
 R-62— $\frac{1}{16}$ " contact, list \$3.50
 R-63— $\frac{1}{16}$ " contact, list 3.70
 R-64— $\frac{3}{16}$ " contact, list 3.90



R-48

Sturdy Construction

$\frac{1}{4}$ K. W. Key Platroid Contact
 List price \$2.80

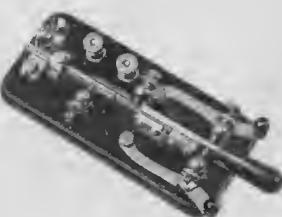
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SEMI AUTOMATIC

OR

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A key of the very latest design for professionals. Increases speed and efficiency.



Has minimum adjustments, very sturdy construction, easily adjusted. Heavy cast base with heavy plated brass parts.

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Polished and lacquered brass base, nickel plated lever, coin silver contacts.

Price \$3.00

LEG KEY

Type M-101

Same as type M-100 except with legs. The legs are used as binding post on this type.

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JUNIOR KEY

Type 112-K

Black enamel key base. Mahogany finish wood base. Nickel plated lever. Coin silver contacts.

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SR. LEARNER SET

Golden finish brass bar frame, sounding plate and key base, aluminum sounding bar, nickel plated key lever, rubber covered coils and mahogany finish base.

M-108—4 ohm, Price \$6.75

M-109—20 ohm, Price \$7.25

M-110—4 ohm, Price \$5.50

M-111—20 ohm, Price \$5.75

M-110 and M-111 same as M-108 and M-109 except sounder plate and key base is steel in place of brass.

The prices on this page are subject to change.

SIGNAL TELEGRAPH INSTRUMENTS



JR. LEARNER SET

Black enamel key base and bar frame. Brass bridge and aluminum sounding bar. Nickel plated key base. Mahogany finish wood base.

M-112—4 ohm, Price \$4.50
M-113—20 ohm, Price \$4.75



SOUNDERS

Sounding plate bar frame and bridge of lacquered brass. Aluminum sounding bar and rubber covered coils. Mounted on mahogany finish wood base.

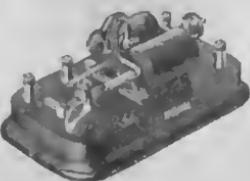
M-102—4 ohm, Price \$3.70
M-103—20 ohm, Price \$4.00



SOUNDERS

Black enamel bar frame, aluminum sounding bar and brass bridge. Mahogany finished wood base.

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M-105—20 ohm, Price \$5.00
M-106—50 ohm, Price \$5.25
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RESONATOR

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We recommend the use of the resonator at all times. The student will find it a great help in memorizing the code by sound. Sounder not included.

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